Chapter 4

Diagnosis and Treatment of Postoperative Complications After Esophageal Reconstruction with Pedicled Intestinal Segments

Esophageal reconstructions belong to complicated and extensive surgical procedures burdened with a significant percentage of postoperative complications. The complications can be divided into two groups. The first group includes complications arising during mobilization of the graft or immediately in the perioperative period and are referred to as early or perisurgical complications. The latter develop long time after the operation and may be considered so-called disorders of the esophageal substitute.

According to literature, the prevalence of early complications ranges from 3.6% to 16%. The number of late complications is significantly higher. According to some authors, very good or good function of the esophageal substitute may be achieved in about 50–65% of patients.

1. Early complications after esophageal reconstruction

1.1. Necrosis of a part or a whole intestinal graft

Complications of this type may develop both, during the operation as well as in the perioperative period. They occur intraoperatively in cases in which assessment of the vascular system in the intestinal segment designated for the graft has been wrong prior to the graft mobilization. At this stage of the surgery, i.e. during evaluation of the type of vasculature and its adequacy, haste is inadvisable, especially that definitely favourable vascular arrangements within the small intestine mesentery occur in 30-40% of population, while definitely unfavourable arrangements are observed in further 30%. The remaining patients have intermediary types, which may prove most difficult to evaluate. For this reason in order to enable more precise assessment of the adequacy of blood supply to the intestinal segment designated for the pedicled esophageal graft, ultrasound Doppler examinations are performed intraoperatively. And even these additional possibilities of evaluating adequacy of circulation do not reduce to the minimum the risk of complications in the form of graft ischaemia. It should be remembered that in sustaining vitality of the mobilized intestinal graft also the venous system plays equally important role. Some authors even believe it is of primary significance. Definite, acute ischaemia of the graft, or definite disturbances in the venous outflow can be diagnosed easily. In case of the former, i.e. acute arterial ischaemia the symptoms are extremely tempestuous and difficult to be overlooked. Acute ischaemia manifests itself in the form of lack of pulsation in the distal straight vessels of the investigated intestinal segment, its pallor, sometimes marble-like appearance of the wall and its cooling. At the same time veins in such cases are evidently less filled with blood. In case of disturbances in the venous outflow with maintained arterial blood flow, the investigated intestinal

segment becomes cyanosed with an evident venous overfilling and stasis, progressive oedema and increased peristalsis in the investigated intestinal segment. However when occlusion of venous outflow is incomplete, the symptoms are definitely less evident, as the wall is slightly cyanosed, sometimes reversibly, and oedema of the wall is almost invisible. The disturbances, very difficult to evaluate, are extremely dangerous, as, like in case of arterial ischemia, lead to necrosis of the graft, while definite clinical symptoms appear few days after initially seemingly normal postoperative course. For this reason some surgical centres perform almost as a routine mobilization of the jejunal graft accompanied by additional vascular anastomoses to support blood supply to the graft. Implementation of this procedure, which improves blood supply, has significantly reduced the number of complications associated with ischemia.

Disturbances in blood supply to the intestinal segment may also occur at further stages of the operation. One of the most significant and very important surgical procedure is to form the retrosternal canal and pass the mobilized graft through the canal onto the neck. The procedure may seem relatively simple. However our clinical experience points to various hazards associated with this stage, including those concerning blood supply to the intestinal segment to be passed through the canal. Due to anatomical conditions in the mediastinum the superior opening of the retrosternal canal from the side of the neck, at the level of the jugular notch of the sternum, is significantly narrower in comparison to the inferior opening from the side of the abdomen. That is why the graft is most exposed to pressure in the superior opening of the canal, just beyond the left sternoclavicular joint, what may contribute to ischemia in the cephalic portion of the graft and its necrosis. For these reasons the superior opening of the retrosternal canal has to be broad enough, both in the frontal as well as in the sagittal planes, to accommodate the intestinal graft together with its mesentery without any pressure. Some surgical centres, as mentioned in previous chapters, remove the left sternoclavicular joint in order to form at this level an adequately broad retrosternal canal. On the other hand, formation of an adequately broad retrosternal canal at the level of inferior entrance, i.e. from the side of the abdomen, in many cases requires radial incision of the diaphragm, sagitally in the canal axis, what successfully broadens the entrance and prevents any pressure exerted possibly by the diaphragm on the graft's pedicle in the retrosternal canal.

Another hazard to the graft's vitality and development of its ischaemia is associated with intestinal torsion around the vascular pedicle in the retrosternal canal, what may easily happen in cases of reconstruction with the ileum or the jejunum, when, in view of the anatomy of the vascular systems, there is a significant excess of the intestine in relation to its mesentery. For this reason passing the graft through the retrosternal canal must be performed extremely gently, and in case of any disturbances in blood supply to the graft, the situation has to be immediately revised and diagnosed, and next removed. Only normally supplied graft authorizes continuation of the operation.

In the perioperative period the main clinical symptoms of the graft's necrosis include pain in the neck and behind the sternum. The symptoms are accompanied by dyspnoea, increased body temperature, accelerated pulse and discharge of blood or brownish matter through the gastric fistula. Physical examination reveals inflammatory oedema with evident tenderness to palpation in the region of the cervical wound. Also the epigastric region is tender to palpation, and when the symptoms of necrosis are fully developed, the symptoms of peritonitis set in. Accessory investiga-

tions, especially chest x-ray reveal evident widening of the mediastinal shadow, and sometimes presence of exudate in the pleural cavity (Fig. 1).

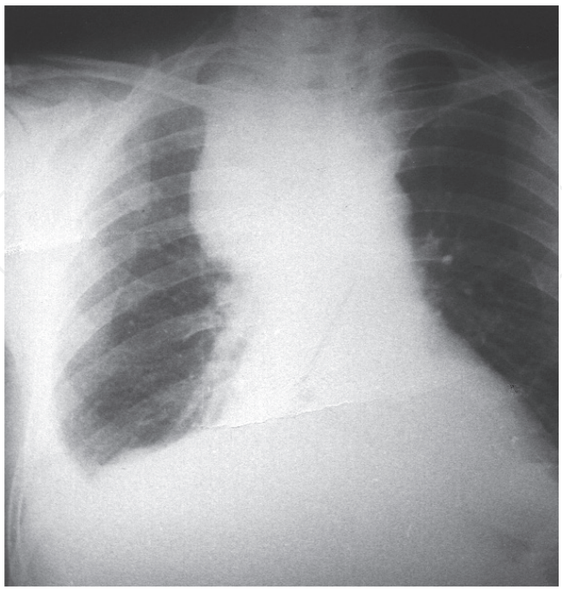

Figure 1 Radiogram of patient's chest with necrosis of the graft (A-P projection). Visible significant dilatation of the mediastinum and exudate in the right pleural cavity

The management of choice is a repeated operation – removal of the necrotic graft, mediastinal and peritoneal drainage, formation of a salivary fistula in the cervical esophagus, management of the opening in the stomach after removed graft and formation of a decompressing gastric fistula, if it was not placed before to feed the patient.

In case of ischaemia and necrosis of the cephalic portion of the graft alone, the clinical symptoms are limited to changes in the neck and inflammatory conditions in the mediastinum occur rarely. The surgical management in such cases is limited to removal of necrotic cephalic portion of the graft, with maintained healthy portion closed in a cul-de–sac manner in the cephalic part, since it may prove useful later on for reparative surgery. Thus prepared remaining segment of the graft has to be placed in the abdominal cavity. Such procedures as formation of a salivary fistula on the neck, drainage of the neck and superior opening to the retrosternal canal as well as decompression of the gastric fistula give chance to save the patient's life. A reparative operation, which consists for example in elongation of the remaining primary graft with another, pedicled or free intestinal graft, may be undertaken at a later stage. Reparative operations of this type are especially complicated procedures and should be performed in highly specialized centres with a significant experience in this field.

Disruption of the graft's pedicle is another, extremely rare complication. This situation may occur during incompetent pulling of the graft through the retrosternal canal, when, after termination of pulling, when the intestine appears in the superior opening of the retrosternal canal, in order to place it higher up in the cephalic direction, the graft is pulled not by the

intestine, but by the pedicle. This fatal complication destroys the graft's vitality practically irreversibly and in principle cannot occur during reconstructive procedure. However, should this situation occur, the damaged graft has to be removed and replaced by another graft mobilized from another intestinal segment.

1.2. Pneumothorax

Another complication, which is associated directly with the performed operation at the stage of formation of the retrosternal canal, is pleural injury and opening of the pleural cavity. During creation of the retrosternal canal it should be remembered that the right and the left mediastinal pleura approach and adhere to each other at the level of the III and IV costal cartilage. The right pleura is often found not in the midline, but it deviates to the left. Thus on creation of the retrosternal canal, especially at the stage of widening of the canal to the sides, there is a risk of pleural injury and opening of the pleural cavity, most commonly on the right side. Pneumothorax, if noticed, in principle does not pose an immediate life-threatening danger. A small opening in the pleura may be sealed quickly by immediate passing of the graft through the retrosternal canal. But it should be remembered that prior to termination of the operation and removal of the endotracheal tube the thorax should be punctured and the lung should be decompressed. Chest x-ray is mandatory immediately following the operation.

Complications may sporadically occur as a result of minor pleural injuries in the perioperative period. On the other hand, long time after the surgery even small pleural injury may lead to the formation of pleural hernia in the esophageal substitute, what will be discussed in subsequent chapters of the review.

1.3. Insufficiency of cervical anastomosis

Complication in the form of insufficient cervical anastomosis occurs rarely. Excluding errors of a technical nature during cervical anastomosis, the complication may occur basically for two reasons. Firstly, whet the intestinal graft in the cephalic portion is poorly vascularized. Secondly, when the cervical anastomosis was performed under significant tension, what usually occurs when the mobilized and pulled through the retrosternal canal graft appears too short.

Clinical findings include inflammatory infiltration on the neck with the presence of salivary fistula. Surgical intervention consists in drainage in the region of the cervical anastomosis and superior entrance to the retrosternal canal. The patient should be nourished through a gastric fistula until healing of the infiltration. Permanent spitting out of the saliva and oral washes with antiseptic solutions provide additionally good effect. Reconstruction of the cervical anastomosis should be considered after healing of the inflammatory condition.

1.4. Salivary fistula in the region of cervical anastomosis

Salivary fistulas belong to most common complications associated with esophageal reconstruction. In majority of cases they do not require repeating of the operation and heal as a result of conservative treatment. However in case of a fistula, after its healing a cicatrical ste-

nosis of the cervical anastomosis may occur, which may be troublesome for the patient on oral feeding, and on many occasion necessitates a reoperation, which in many cases may prove more difficult than the whole reconstructive surgery (Fig. 2).

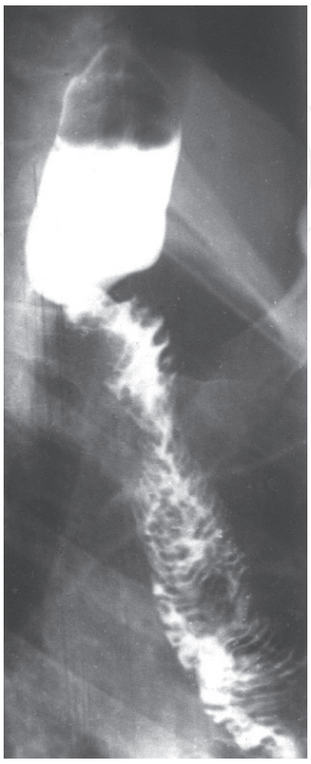

Figure 2 Radiogram of esophageal substitute from the jejunum (oblique projection). Visible anastomotic cervical stenosis after healed fistula

Review of literature on the problem demonstrates explicitly that cervical anastomotic fistulas are significantly more commonly observed after reconstructions with the colon than after operations with the use of the small intestine. Numerous authors see the reasons for this condition in a lack of peristalsis in the colon graft, inadequate lumen between the cervical esophagus and the colon, and, additionally, the presence of bacterial flora in the colon, what provides favourable conditions for the development of a fistula, in contrast to reconstructions with the small intestine, which are characterized by vivid peristalsis, lumen comparable to the esophagus as well as bacterial flora different than in the colon. Moreover, opinion of the authors who see the reasons for development of cervical anastomotic fistulas in insufficient blood supply to the region of the anastomosis, e.g. as a result of thrombi in small veins, seems highly justified.

The clinical image of a cervical anastomotic fistula is relatively characteristic and does not pose any diagnostic problems. The fistula usually manifests itself about 6-7 days after the surgery. A limited, not very diffuse inflammatory infiltration appears in the region of the wound scar, often similar to those which may be observed in non-healed subcutaneous ligatures. On opening of the infiltration there is visible salivary leakage. The patient usually does not report any complaints at this time. Oral administration of a small amount of boiled water stained with methylene blue reveals leakage of

the stain and saliva through the fistula to the dressing. Another method to confirm the presence of a cervical fistula is to administer orally aqueous solution of a contrast medium and x-ray the patient. However if the fistula is small, it is not always demonstrated on radiological examination, although the presence of a fistula is certain clinically. In conservative treatment, apart from changing dressings several times a day, it is most important to exclude feeding by mouth, constant spitting out saliva and washing the oral cavity with antiseptic solutions several times a day and always before the night. In this time the patient is nourished through a gastric fistula.

1.5. Injury of the recurrent laryngeal nerve

Injury of the recurrent laryngeal nerve belongs to relatively rare complications and affects about 6% of the operated patients. It occurs during preparation and isolation of the cervical esophagus prior to cervical anastomosis with the graft and is most commonly associated with brutal manipulations in the region of the nerve. In order to avoid this complication, far reaching care and delicacy during performance of the cervical stage of the reconstructive surgery are highly recommended.

Injury of the recurrent laryngeal nerve manifests itself in the form of hoarseness, and laryngological examination reveals vocal cord paralysis on the side of injured nerve. As mentioned above, the complication is not severe and does not impair in a significant way the function of the esophageal substitute.

2. Diagnosis and treatment of late complications after esophageal reconstructions

Long-term complications after esophageal reconstructions may be divided into two main groups. The first group includes these complications which impair the basic function of the esophageal substitute; the latter encompasses so-called disorders of the esophageal substitutes, which, in principle, may be mainly attributed to conditions and disorders associated with gastric, and often biliary reflux to the esophageal substitute. The new esophageal substitute created from a segment of the small intestine or colon, is not equipped with adequate defense mechanisms as a natural esophagus. Rare diseases of esophageal substitutes, such as malignant tumours, which may occur 20-30 years after the reconstructive surgery, constitute a separate group of rare conditions and are described in literature as single case reports.

In the opinion of various surgical centres, very good or good function of the esophageal substitutes is reported in about 50-65% of the patients. The remaining cases are affected by various disorders and/or diseases of the esophageal substitutes, which significantly impair the quality of feeding. The changes often pose significant diagnostic difficulties and on many occasions require complicated repair procedures.

The diagnosis of disorders of the esophageal substitutes is not easy, the more that the possibilities of accessory investigations are to some extent limited mainly due to topographic changes associated with the reconstructive procedure. For this reason it seems justifiable to present in this place the diagnostic possibilities in patients after esophageal reconstructions.

2.1. Diagnosis of the esophageal substitute

Radiological examinations

The diagnosis of the esophageal substitute is not easy, and the scope of diagnostic procedures is limited. For many years, prior to the introduction of endoscopic procedures, accessory investigations after esophageal reconstructions were limited only to radiological assessment with the use of contrast medium and laboratory tests evaluating function of the esophageal substitute on the basis of possible disturbances in the absorption of basic substances, like proteins, lipids, carbohydrates, vitamins, etc.

However radiological examinations, which present a definite image as far as the passage through the esophageal substitute is concerned, do not allow precise diagnosis and evaluation of certain disorders of the esophageal substitutes, such as for example inflammatory conditions associated with reflux. The role of endoscopy cannot be overestimated in this respect, as it not only enables diagnosis of inflammatory conditions, but also informs about their severity and provides many other opportunities, which will be discussed in further chapters devoted to disorders of the esophageal substitutes and their treatment. Despite the above-mentioned advantages and benefits associated with the introduction of endoscopic methods to the diagnosis of disorders of the esophageal substitutes, the role of radiological examinations is still valuable. Radiological examinations remain an indispensable tool in the diagnosis of many cases and many disorders, such as for example pleural hernia, or examinations evaluating passage through the esophageal substitute. And although the latter cases, i.e. passage of food through the esophageal substitute may be evaluated by means of isotope examination, they are less frequently used due to significant costs. Other radiological methods include computerized tomography and magnetic resonance. Apart from high costs of the examinations, both diagnostic methods are not always specific and tender enough in relation to changes which may occur in the esophageal substitute. On the other hand, endocavital ultrasound evaluation seems to reveal new diagnostic possibilities, as it allows evaluation of changes in the walls of the investigated organs.

Endoscopy of the esophageal substitute

The endoscopic technique is difficult, what is associated with the topography of the esophageal substitute in the anterior mediastinum. Such a position of the graft requires forward relocation of the cervical segment of the esophagus from the prevertebral space towards the anterior mediastinum in order to enable anastomosis with the graft. Cervical end-side-to-side anastomosis with the throat or cervical esophagus is advantageous in this respect that the anastomosis lumen is relatively wide and even in case of complications in the form of salivary fistula, after healing the anastomotic stenosis is uncommon. However this type of cervical anastomosis, together with a new position of the cervical portion of natural esophagus contribute to a difficult passage from the throat to the portion reconstructed with the intestinal segment and further, to distal part of the esophageal substitute on endoscopic examination. The endoscope has to turn twice at the angle of 70^0 on a short distance. The first turn is necessary to pass through the cervical anastomosis, the second – after getting through the cervical anastomosis, i.e. on passage from the prevertebral space on the neck to the anterior mediastinum, i.e. the retrosternal canal (Fig. 3). Another difficulty

in this region is associated with an osteoarticular limitation – the left sternoclavicular joint. After passing the endoscope through this segment and its insertion to the esophageal substitute in the retrosternal canal, it should be remembered that in many cases, especially after reconstructions with the jejunum or ileum, the esophageal substitute in this region is quite tortuous, what poses additional difficulties on endoscopic evaluation. Another drawback on endoscopy is connected with immobilization of the tortuous course intestine by numerous adhesions to the surrounding tissues, what significantly hampers the examination and does not allow straightening of the intestine. Thus, undertaking a trial to evaluate the esophageal substitute by means of endoscopic examination, the endoscopist has to be aware of all the difficulties and hazards associated with the unskillful performance of the procedure. Endoscopic examination should be performed by an endoscopist with high expertise. Moreover, good knowledge of technical details of various types of esophageal reconstruction, which facilitates maneuvering in topographic conditions which had been changes during the operation is mandatory.

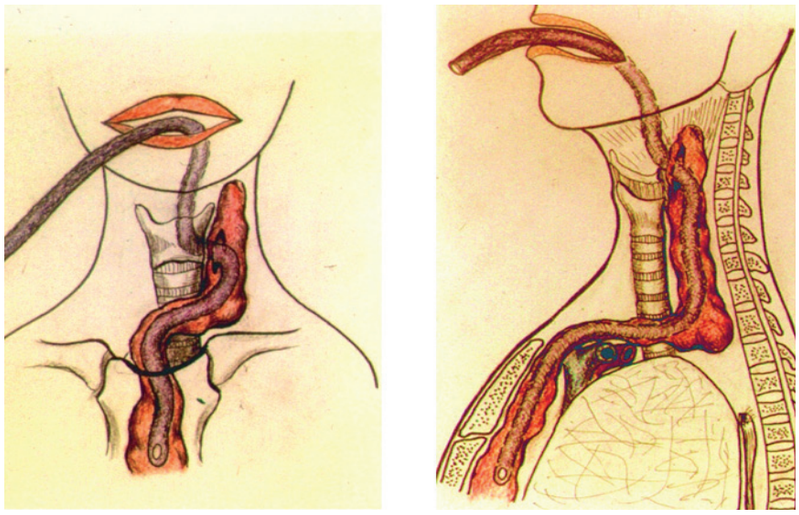

Figure 3 Endoscopy of the esophageal substitute (A-P and lateral projection)

Introduction of endoscopic technique to evaluation of the esophageal substitute opens a number of both, diagnostic and therapeutic possibilities. Endoscopy provides opportunity to evaluate the esophageal substitute, possible changes within the mucous membrane and their severity. It also evaluates the function of the stomach, the efficacy of its emptying and the presence of gastric or biliary reflux to the esophageal lumen. Moreover, it enables detection and treatment of changes originating in the esophageal substitute many years after the reconstructive procedure. Thanks to endoscopic technique, it possible in many cases to make proper diagnosis, when other accessory investigations fail.

The advantage of endoscopy lies not only in the fact that it enables an exact diagnosis, but it also allows implementing adequate therapy. This concerns bleedings, which may be controlled by means of endoscopic methods, or the presence of polyps in the esophageal substitute, which may be removed endoscopically. Thus the above-mentioned endoscopic methods permit more exact diagnosis and, in many cases, treatment of esophageal substitutes without the necessity of complicated repair procedures.

2.2. Late complications in the region of cervical anastomosis

Abnormal functioning of the esophageal substitute may be affected by a number of factors. Among them, the decisive role is played by the type of cervical anastomosis. In the reconstructive surgery of the esophagus an end-to-end anastomosis is most commonly employed. The side-to-side, or end-to-side anastomoses also find their place, but they are used rarely and are reserved for selected cases. However in our experience, an end-side-to-side anastomosis, also referred to as an "oblique" type, allows to attain sufficient diameter of the cervical anastomosis and thus gives a better functional outcome.

2.2.1 Cicatrical stenosis of the cervical anastomosis

Cicatrical stenosis of the cervical anastomosis is the most common complication occurring long time after the reconstructive procedure. It is usually preceded by the presence of even a small fistula in the region of cervical anastomosis, which, after healing contributes to formation of a cicatrical stenosis. The above complication is observed definitely more often after an end-to-end anastomosis and after reconstructions with the use of a pedicled colon segment. As mentioned before, the reason for this complication is sought in a diverse physiology of the colon in comparison to the small intestine, as well as in an even slight ischaemia at the site of the anastomosis.

Depending on the degree of the anastomotic stenosis, the patient may experience more or less pronounced difficulties on swallowing. Radiological examination reveals narrowing of the cervical anastomosis, often with evident dilatation of the cervical esophagus before the anastomosis and retention of the contrast medium (Fig. 4, 5). In, luckily, few cases an almost complete cicatrical occlusion of the anastomosis may develop, what is associated with an additional hazard in the form of aspiration pneumonia. The patient in such a case complains of a troublesome necessity of constant spitting out saliva which accumulates in the mouth, and at night choking may often occur, leading to respiratory infections (Fig. 6).

Figure 4 Radiogram of esophageal substitute from the colon (A-P projection). Visible cicatrical stenosis of the cervical anastomosis after healed fistula

Figure 5 Radiogram of esophageal substitute from the jejunum (A-P projection). Visible cicatrical stenosis of the cervical anastomosis after healed fistula

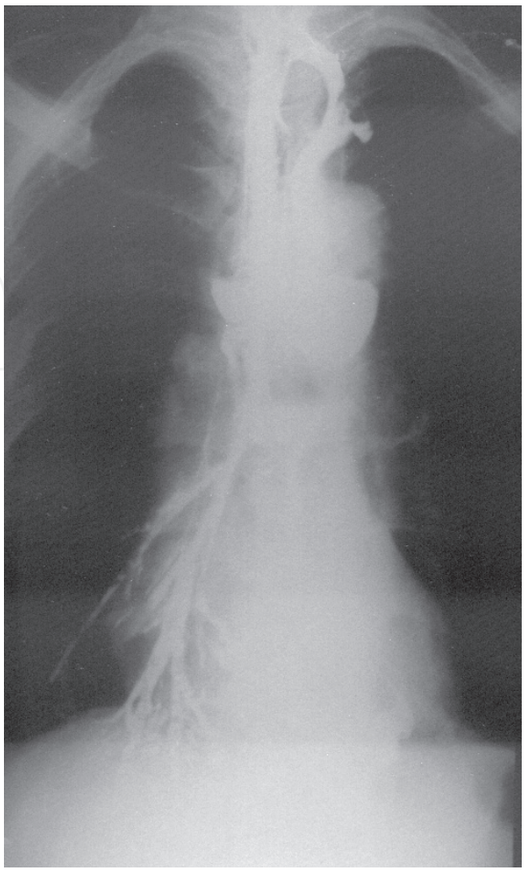

Figure 6 Radiogram of a significant stenosis of cervical anastomosis after esophageal reconstruction with the colon (A-P projection, examination with aqueous solution of contrast medium). The patient chokes. Bronchial tree filled with contrast medium

In case of less extensive stenoses, a good outcome may be achieved by means of an endoscopic dilatation. This usually requires several sessions, during which the stenosis is dilated until a desired diameter is obtained, i.e. about 15 mm. On the other hand, if the cicatrical anastomotic stenoses are extensive, repair procedures: reconstruction of the anastomosis (reanastomosis), or bypassing are necessary. The final decision as to the reconstructive technology is made during the procedure in relation to the intraoperatively observed local conditions at the site of the anastomosis. It is worth noting that the procedures, seemingly easy, may pose many technical problems, starting from difficulties in preparation of a segment of the cervical esophagus and the cephalic portion of the esophageal substitute, with the vascular pedicle as its most important element, which usually adheres most to the surrounding tissues. Destruction of the vascular pedicle in this region results in a loss of the cephalic segment of the esophageal substitute due to lack of blood supply. Further difficulties are associated with repeated cervical anastomosing. It should be remembered that both, the cervical portion of the esophagus, and primarily the cephalic portion of the esophageal substitute are difficult to mobilize, and often so firmly fixed with adhesions, that they become practically impossible to

mobilize. Thus sometimes the repair operation in this region may exceed in difficulty the whole reconstructive procedure. According to experience, any repair procedures on esophageal substitutes should be performed in specialist centres with high level of expertise in this matter, as damage inflicted by improper conduct of the procedure may prove difficult to repair even in a specialist centre.

2.2.2. Diverticula in the region of cervical anastomosis

Diverticula in the region of cervical anastomosis are often observed after an end-to-side, or end-side-to-side anastomoses. They usually occur when too long, blind intestinal stump is left in the region of the anastomosis. Initially after the surgery the complaints are almost imperceptible for the patient, however with time the diverticulum enlarges, fills with saliva and food and, exerting pressure on the cervical anastomosis, may significantly impair the act of swallowing. The condition becomes especially important after reconstructions with the colon, when active peristalsis is absent, and the swallowed food passes downwards driven mainly by the force of gravity. Thus emptying of such a diverticulum is significantly hampered, and constant retention of food content contributes not only to impaired swallowing, but also to inflammatory changes and/or ulceration in the diverticulum.

Main complaints reported by the patients include difficulties on quick swallowing of food, and sensation of retention of food in the neck during meals. When the diverticulum is small, patients try to eat slowly, drink abundantly during meals, and a gentle massage in the region of the diverticulum, which the patients perform themselves, facilitates its emptying. Endoscopic examination is very difficult and dangerous in such cases due to the possibility of puncturing of the diverticulum, to which the end of the device falls notoriously and then visualization of the cervical anastomosis, which is located on the posterior-lateral wall is very difficult. However radiological examination, which reveals perfectly the diverticular dilatation of the blind stump on the neck together with the retained contrast medium seems invaluable (Fig. 7).

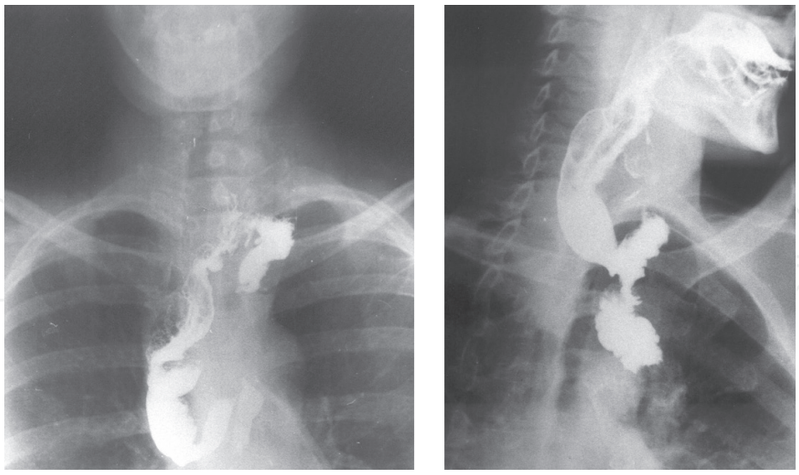

Figure 7 Radiogram of esophageal substitute from the ileum visualizing diverticulum in the region of cervical anastomosis (A-P and lateral projections)

In such cases a repair procedure in which the intestinal excess creating the diverticulum is excised is the treatment of choice. The surgical procedure is much easier in comparison to

this described above for cicatrical anastomotic stenosis in the cervical region. The principle of a precise preparation of the cephalic portion of the graft has to be maintained definitely, the pedicle has to be identified, and the diverticulum excised safely without injuring the pedicle. Major difficulties may occur in cases of large diverticula, as they often are arranged in such a way that their apices descend low towards the mediastinum and their preparation may cause significant problems, the more that diverticular walls, constantly stretched by retaining saliva and food, become significantly thinner. In such cases delicacy and special care during preparation of the diverticulum and well recognition of the topographic conditions are mandatory.

2.2.3. Pleural hernia of the esophageal substitute

Pleural hernias originate as a consequence of unnoticed even small injury to the mediastinal pleura at the stage of preparation of the retrosternal canal. They occur more commonly on the right side, left-sided hernias are rare. The reason lies in the topography of the anterior mediastinum.

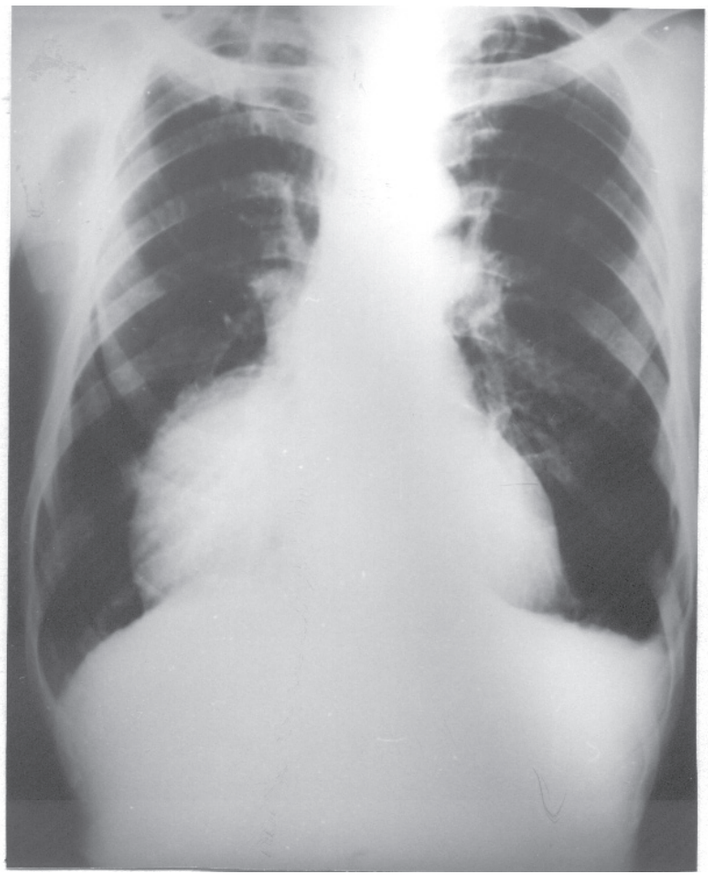

Figure 8 Radiogram of patient's chest with a visible right pleural hernia of the esophageal substitute – visible shadowing of the lower right lung (A-P projection)

The mediastinum is limited in front by the sternum and partly by the costal cartilage, in behind – by the spinal column, and on the sides – by the right and left mediastinal pleura. The anterior border of the right pleura runs behind the sternum, reaches the midline, and even

passes it on the left, to pass into the lower border at the level of VI intercostals space. The anterior border of the left pleura, running downwards, reaches the cartilage of the IV rib, next it deviates to the left, crosses the V rib cartilage and reaches the VI rib, where passes to the lower border. The right and the left mediastinal pleuras approach each other at the level of the III –IV costal cartilage. Thus two free triangular interpleural spaces are created – the superior and the inferior ones. The superior space is filled with adipose tissue and the remains of the glandula thymi, while the inferior one is filled with the pericardium, which at the level of costal cartilages at the site of their sternal attachment, is not covered with the pleura. For this reason on formation of the retrosternal canal, the pleura is more often injured on the right side.

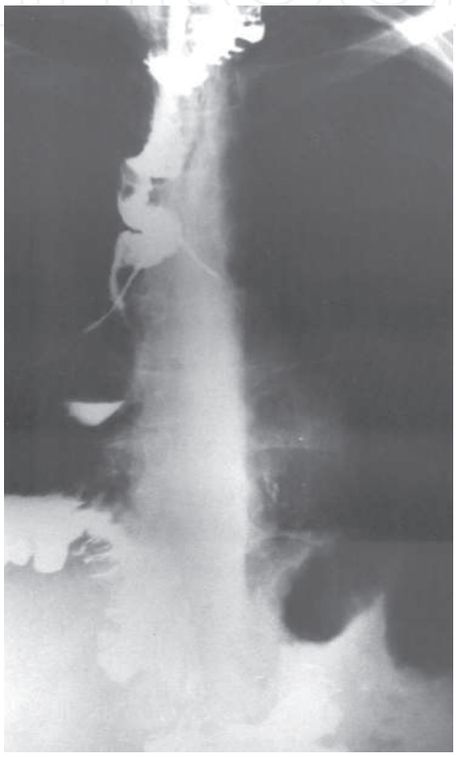

Figure 9 Radiogram of esophageal substitute from the ileum and right colon (A-P projection). Distal portion of the esophageal substitute filled with contrast medium visible in the right pleural cavity (right pleural hernia)

Figure 10 Radiogram of esophageal substitute from the ileum and right colon (A-P projection). Distal portion of the esophageal substitute filled with contrast medium visible in the left pleural cavity (left pleural hernia)

Initially pleural hernia is asymptomatic. However chest pain, which aggravates on meals, especially profuse, may set in with time. The pain often of a distending character is accompanied by sensation of dyspnoea and difficulties on breathing. Patients often assume lying position on the side contralateral to the hernia, what brings relief, as facilitates intestinal emptying, they also consume smaller portions of meals in fear of complaints.

Physical examination, especially auscultation often reveals distinct weakening of the alveolar murmur in the lower lungs, often associated with audible rumbling and flowing on the side of the hernia. Due to permanent limitation of the size of meals, the patients may with time

develop undernourishment and anaemia, and permanently impaired lung ventilation contributes to oxygen deficiency, what may be easily confirmed on gasometry and spirometric evaluation. Chest x-ray reveals shadowing of the pulmonary field on the side of the hernia as well as shadow of the esophageal substitute filled with air with level of fluid (Fig. 8). The image is completed with contrast examination of the upper gastrointestinal series (Fig. 9, 10).

Examination with contrast medium determines not only the size of the hernia, but also evaluates passage of the contrast medium and duration of its retention in the intestinal segment in the hernia. Endoscopic examination is as much significant in these cases as it enables identification of possible inflammatory conditions and determination of their severity in the intestinal segment involved in the hernia, what may be extremely valuable and provides basis to implement supportive pharmacotherapy.

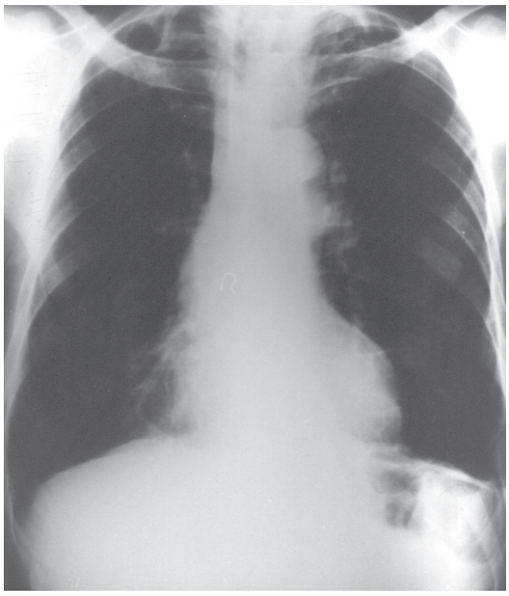

Figure 11 Chest x-ray after repair surgery of the right pleural hernia of the esophageal substitute (A-P projection)

Figure 12 Radiogram of the esophageal substitute after repair surgery of the right pleural hernia (lateral projection)

The only effective therapy for pleural hernia is a repair surgery. Such operations belong to extremely difficult procedures, performed in topographic conditions which have been altered completely by the reconstructive surgery and the presence of the hernia. Moreover, a fear not to damage the graft's vascular pedicle exacerbates hazards of the operation. Generally speaking, the repair procedure consists in opening of the abdominal cavity from upper midline incision prolonged onto the sternum, preparation of the intestinal loop from the pleural cavity, its placement and stabilization in the anterior mediastinum and closure of the hernia ring. The most effective modality to achieve this is to prepare the intestinal loop, excise its excess and perform anastomosis reconstructing continuity of the graft. The most hazardous stage of the repair procedure is the preparation of the caudal segment of the esophageal substitute, which usually adheres firmly to the sternum, and especially its pedicle. A longitudinal incision of the sternum in the lower part often proves helpful, as it facilitates separation of the graft and provides access to the hernia. On

completion of this stage of the procedure, the hernia has to be managed and its recurrences prevented. Removal of the intestinal loop from the pleural cavity does not usually pose any problems, as it is generally surrounded by soft, delicate adhesions, which can be easily released. However the pedicle is surrounded by solid and tough adhesions, the separation of which at any cost may bring an unfavourable outcome as far as vitality of the graft is concerned. Thus in cases of a significant excess of the intestinal loop, which forms the hernia, after getting the intestine out of the pleural cavity and bringing it to the anterior mediastinum, it is more advantageous to perform intestine-to-intestine anastomosis within the elongated loop, what shall facilitate emptying of the esophageal substitute, improve passage, and at the same time, prevent recurrences thanks to stabilization of the intestine by the performed anastomosis (Fig. 11, 12).

In extreme cases, when hernia reaches significant size, and its removal from the pleural cavity is associated with an inevitable injury to the pedicle, it is better to give up and abandon the idea of bringing the intestinal loop to the mediastinum, instead, a relatively broad additional intestinal anastomosis within the elongated loop should suffice. Such a management facilitates passage and improves emptying of the esophageal substitute and definitely ameliorates the symptoms of hernia.

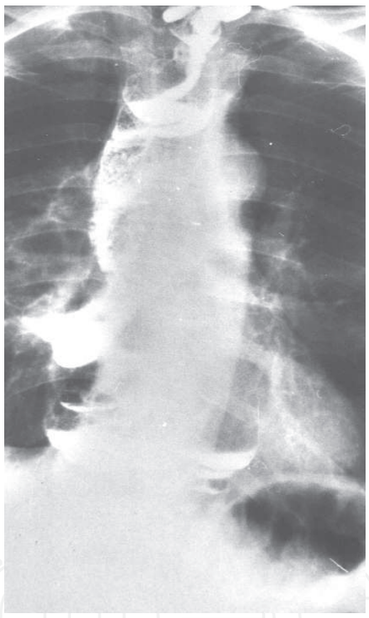

Figure 13 Radiogram of obstruction of the esophageal substitute from the colon due to right pleural hernia (A-P projection). The examination was performed with aqueous solution of contrast medium

Figure 14 Radiogram of the same patient after repair surgery of the esophageal substitute occlussion (lateral projection)

Acute obstruction of the esophageal substitute is a serious, but extremely rare complication of pleural hernia. This complication may occur as a result of torsion of the elongated intestinal loop along its axis (Fig. 13). The situation requires immediate, lifesaving surgical intervention, and the procedure is extremely difficult and there are no conventions for the surgical procedure (Fig. 14). In extreme cases, when volvulus resulted in development of necrosis, the necrotic segment has to be excised and the procedure should follow steps described in the chapter:" Necrosis of a part or a whole intestinal graft".

2.2.4. Complications associated with reflux to the esophageal substitute

After reconstructive operations, when the barrier function of the cardia has been abolished, reflux of the gastric content to the esophageal substitute is very common. The mucous membrane of the intestine, which forms the esophageal substitute, is completely non-resistant to acid gastric content and undergoes inflammatory changes of various severity – from irritation and mild inflammation to haemorrhagic inflammations and ulcerations, which may in turn even lead to life threatening conditions. Clinical experience shows that the changes more often occur in esophageal substitutes from colon than those from the small intestine, which have vivid and unidirectional peristalsis, what not only accelerates the passage, but also protects against reflux. Additional barrier is provided by a long abdominal portion of the esophageal substitute anastomosed to the prepyloric part of the stomach. Another method of reflux prevention is provided by effective patency of the pylorus. It should be remembered in case of esophageal reconstructions of post-burn scars in the pyloric part of the stomach and after esophageal resections due to cancer, when the anterior and posterior trunks of the vagus nerve were cut. Restoration of gastric patency should be performed prior to esophageal reconstruction. Less patent pylorus facilitates reflux to the esophageal substitute, which, in the region of anastomosis with the stomach, is deprived of any barrier mechanism. The complaints are relieved after operation of restoration of pyloric patency (Fig. 15,16).

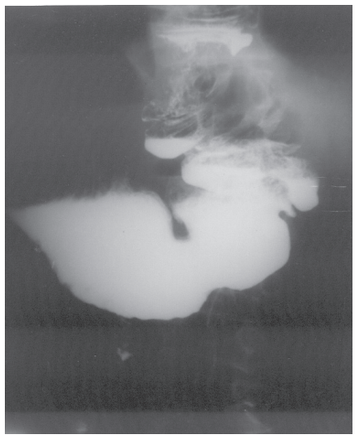

Figure 15 Radiogram of the stomach and distal portion of the esophageal substitute from the colon (A-P projection). Visible narrowing of the pylorus and deposition of contrast medium in the stomach and esophageal substitute

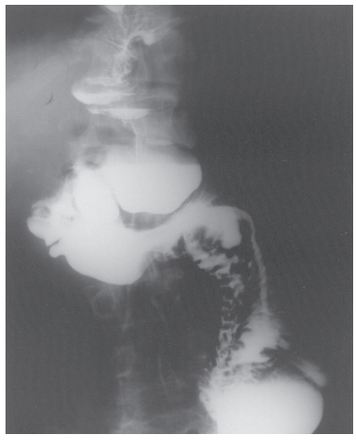

Figure 16 Radiogram of the stomach and distal portion of the esophageal substitute in the same patient after surgical restoration of gastric patency - gastro-enteroanastomosis antecolica with entero-enteroanastomosis modo Braun (A-P projection)

Prolonged reflux to the esophageal substitute leads to the development of inflammatory changes, ulcerations, haemorrhagic changes and even cicatrical stenosis.

The clinical picture of reflux is characterized by pain of retrosternal location. It may be accompanied by acid belching, sensation of squeezing, burning and tearing behind the sternum, especially after big, heavy or spicy meals. The use of neutralizing agents and eating more often light meals in smaller portions brings relief.

In order to make the diagnosis, apart from radiological evaluation, endoscopic examinations with a biopsy are very useful as they enable determination of the severity of inflammatory changes in the esophageal substitute and rule out possible neoplastic changes (Fig. 17, 18, 19, 20).

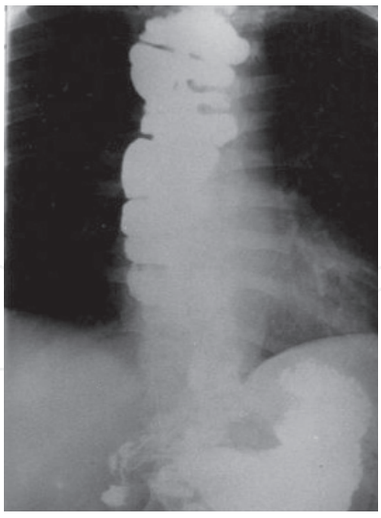

Figure 17 Radiological image of a massive reflux to the esophageal substitute from the colon in Trenelenburg's position (A-P projection)

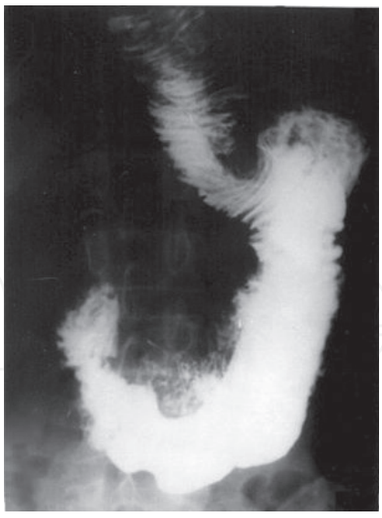

Figure 18 Radiological image of a massive reflux to the esophageal substitute from the colon visible in Trendelenburg's position, resulting from anastomosis of a distal portion of the graft with the fundus of the stomach (A-P projection)

The use of endoscopy permits to differentiate individual stages of the disease and institute adequate conservative therapy as well as evaluates the efficacy of the applied therapy.

Conservative treatment is effective with prokinetic drugs and agents protecting the mucous membrane in combination with proton pump inhibitors (PPI). In few cases healing of the inflammatory changes or ulcerations may lead to cicatrical stenosis of the distal portion of the esophageal substitute, which require complicated repair procedures together with partial excision of the distal portion of the graft and a consecutive necessity to reconstruct the continuity of the esophageal substitute by means of a pedicled insertion from the jejunum or omega-shaped jejunal loop (Fig. 21, 22, 23, 24, 25).

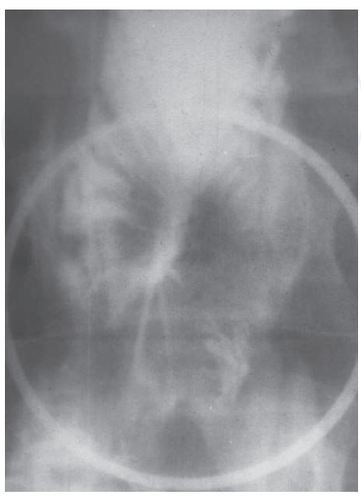

Figure 19 Radiogram imaging ulcer in a distal portion of the esophageal substitute from the colon (A-P projection)

2.2.5. Benign and malignant tumours of the esophageal substitute

Both, benign and malignant tumours of the esophageal substitute are rare and in there are only single case reports in literature. Reasons facilitating such changes in the esophageal substitute undoubtedly include an altered function of the small or large intestine which it starts to perform as an esophageal substitute. In the esophageal substitute the intestinal mucous membrane, permanently exposed to direct effect of food and contained in it chemicals, high temperature of ingested meals, and quite often – reflux, easily undergoes changes, which may become a background for neoplastic processes.

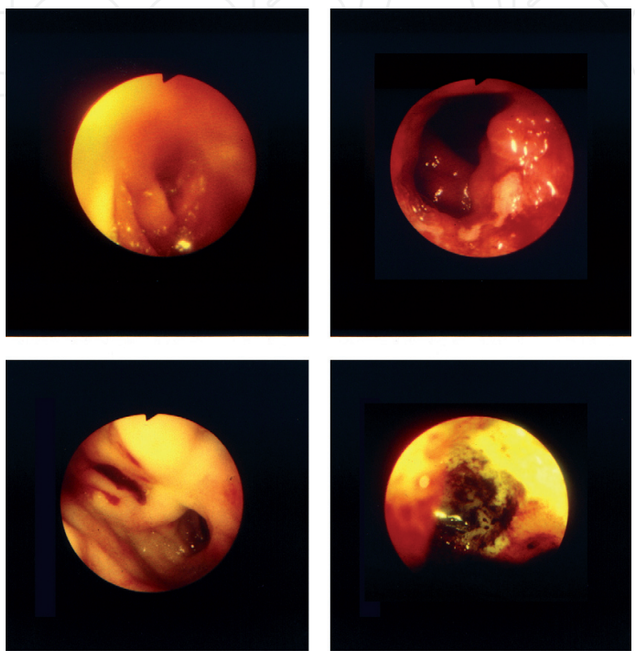

Figure 20 Endoscopic pictures imaging various stages of reflux-induced inflammation of the esophageal substitute from the colon – from inflammatory changes to haemorrhagic ulcerations

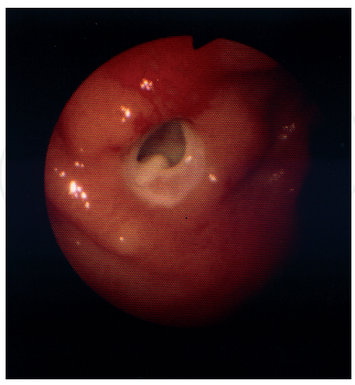

Figure 21 Endoscopic image of reflux-induced cicatrical lesions in the esophageal substitute from the colon

Polyps constitute one of better recognized precancerous conditions of the gastrointestinal tract. Polyps require resection and histopathological evaluation is indispensable, which decides whether there was a neoplastic transformation within the polyp. The fact that many disorders and conditions within the colon are asymptomatic for a long time is unquestionable. For this reason prior

to reconstructive procedure endoscopic evaluation of the colon is mandatory. Moreover, periodic endoscopic examinations of patients after esophageal reconstructions with the colon should be a rule (Fig. 24). It enables detection and excision of possible polyps in the esophageal substitute, what prevents their malignant transformation, which, if occur, may require removal of the whole esophageal substitute (Fig. 26, 27).

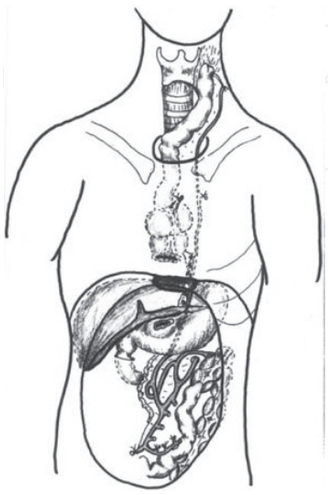

Figure 22 Diagram illustrating resection of distal portion of the esophageal substitute from the colon. Visible maintained continuity of the vascular pedicle

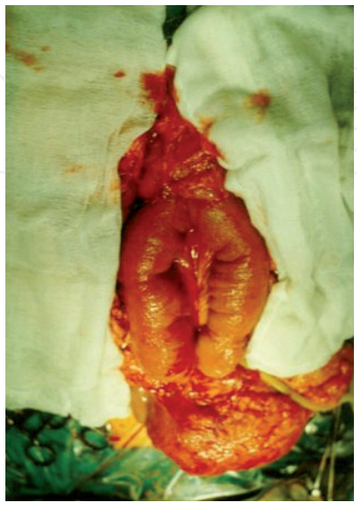

Figure 23 Intraoperative image of an omega-type insertion from the jejunum after resection of a distal portion of the esophageal substitute from the colon due to reflux-associated cicatrical stenosis

During endoscopic removal of polyps in the esophageal substitute, it should be remembered that injury to the wall may result in puncturing the intestine and life threatening complications. For these reasons the procedure should be performed in the endoscopy centre familiar with the problems of endoscopy of esophageal substitutes.

Figure 24 Radiogram of an omega-type insertion from the jejunum after resection of a distal portion of the esophageal substitute from the colon due to reflux-associated cicatrical stenosis

Figure 25 Radiogram of a pedicled insertion from the jejunum after resection of a distal portion of the esophageal substitute from the colon due to reflux-associated cicatrical stenosis

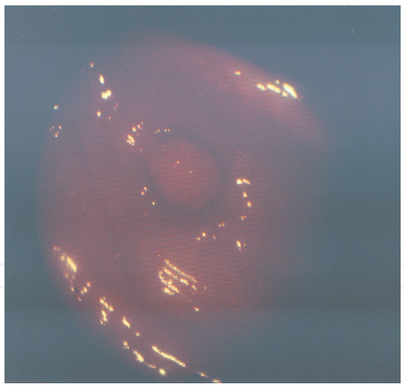

Figure 26 Endoscopic image of polyp in the esophageal substitute from the colon

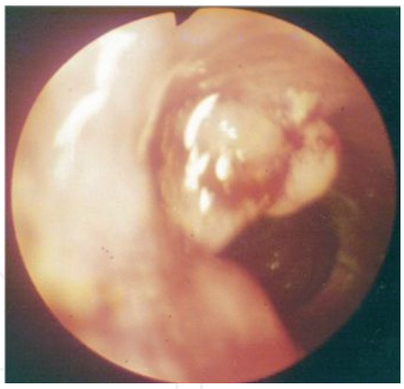

Figure 27 Endoscopic image of cancer in the esophageal substitute 30 years after esophageal reconstruction

Recapitulating the above presented early complications after esophageal reconstruction and disorders of the esophageal substitutes, it should be emphasized that patients after such procedures should be permanently followed up in specialized centres. Only then can they use indispensable information, and in case of any complaints, may count on periodic check up examinations, and if required – expert assistance and medical care.

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